CORRECTION OF CLERICAL ERROR

SPECIFICATION No. 520,247

The following correction is in accordance with the Decision of the Superintending Examiner, acting for the Comptroller-General, dated the tenth day of July, 1940:-

Page 2, lines 117 and 118, *for* "glasses Nos. 7 and 8." *read* "glass No. 7".

THE PATENT OFFICE,
August 1st, 1940.

PATENT SPECIFICATION

Convention Date (United States): Dec. 30, 1937.

520,247

Application Date (in United Kingdom): Oct. 15, 1938. No. 29922/38.

Complete Specification Accepted: April 18, 1940.

(Under Section 91, subsections (2) and (4) of the Patents and Designs Acts, 1907 to 1938, a single Complete Specification was left in respect of this Application and of Application No. 29921/38 and was laid open to inspection on April 17, 1939.

COMPLETE SPECIFICATION

New and Improved Glass Compositions for the Production of Glass Fibres

We, NAAMLOOZE VENNOOTSCHAP MAATSCHAPPIJ TOT BEHEER EN EXPLOITATIE VAN OCTROOIEN, a Company organized under the laws of Holland, of No. 57 Zeekant, The Hague, Holland, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

In our copending Application No. 29921/38 there is described and claimed electrical insulation composed of glass fibres which are free or substantially free from alkali but it has been found that such alkali-free glass fibres are capable of wider application and other uses and accordingly the present invention relates to a glass free or substantially free from alkali ingredients, for the production of glass fibres, and to glass fibres produced from such non-alkaline glass.

Refractory glasses or glasses for electric discharge devices have been proposed with a low alkali content, or practically free from alkali.

When glass is drawn into fibres for insulation or textiles, the fibres or filaments which are fine enough for such service present an enormous surface. Any alkali of the glass which lies on or near the surface imparts to this surface a hygroscopic property. Water absorbed from the atmosphere dissolves the alkali, and the resulting solution attacks the silicate and starts a cycle which culminates in the destruction of the fibres. When the fibres are used for electrical insulation the presence of alkali may render glass itself a conductor, particularly at elevated temperatures. Also, the soluble alkali on the hygroscopic surface allows ionic conduction to proceed. With glass fibres the action of the alkali is the more severe because the surface of the fibres is enormously large in relation to the mass.

While the removal of the alkali from the glass results in a great improvement in the durability and electrical resistance, this is an extremely difficult thing to accomplish. Non-alkaline glasses in which the alkali has been replaced by alkaline earth or even with such violent fluxes as calcium fluoride, are generally extremely refractory, and even though they may be melted, the rate of solution of the raw batch is so slow that excessive time and temperatures are required for commercial practice. Moreover, such glasses do not have the ordinary physical stability of alkali glasses and easily revert to the crystalline state. Also glasses of this nature have short temperature ranges in which the viscosity is suitable for forming or attenuating operations. Since the working range is shorter and occurs at temperatures at which the heat losses are rapid, it is difficult or impossible to form the glass without excessive alterations of equipment and practice.

We have also discovered that non-alkaline glasses are extremely critical in their allowable ranges of ingredients. Slight changes in batch formulas work a revolutionary change in the glasses.

An object, therefore, of the present invention is to provide a non-alkaline glass composition which may be easily melted in a relatively short period of time, for example, the time ordinarily necessary for alkali glasses. The composition of the non-alkaline glass according to the invention is such that the glass has a high viscosity and moves sluggishly when liquid. The novel glass composition is easy to melt and will not foam excessively during the melting process. The glass is workable, that is, has a sufficiently broad viscosity curve so that useful articles may be fabricated therefrom. In this connection, the composition of the glass is of character which is not too critical in its viscosity and temperature curve in order that the conditions of control are not too difficult.

The non-alkaline glass may be made, if

desired, clear and bright, rather than colored or black.

The invention consists primarily in a narrow range of non-alkaline glass compositions which we have discovered lying in a critical eutectic range. Alkali fluxes can be avoided without sacrificing the necessary working properties and yet producing the highly desirable properties of durability and high electrical resistance. The simple or base glass may have added thereto auxiliary fluxes but they do not change the basic relationship of the proportions of the ingredients entering into the base glass.

The base glass consists of a specific mixture of lime, magnesia, alumina, and silica. These ingredients, when properly proportioned in accordance with the present invention, possess intrinsic glass-forming characteristics. They melt at moderate temperatures and resist devitrification to a marked degree. The simple or base glasses comprising the invention lie within a eutectic bounded substantially by the following limits:

CaO	- - -	16 to 30%
MgO	- - -	7 to 1%
Al_2O_3	- - -	17 to 7%
SiO_2	- - -	67 to 53%

Preferably, however, the base glass lies within the following ranges:

CaO	- - -	18 to 28%
MgO	- - -	7 to 1%
Al_2O_3	- - -	17 to 9%
SiO_2	- - -	65 to 55%

The easiest melted composition indicating the dominating eutectic is approximately as follows:

CaO	- - - -	27%
MgO	- - - -	4%
Al_2O_3	- - - -	9%
SiO_2	- - - -	60%

It is to be noted that the dominating eutectic is not in the middle of the ranges above noted but well toward the upper limit of lime and the lower limit of alumina. Such a glass is best adapted for inexpensive products such as insulating wool. However, the glasses toward the upper limit of alumina have more desirable properties, better viscosity curves, and make the best glass textiles. Thus, examples of specific base glasses are as follows:

		1.	2.	3.
CaO	-	20.0%	23.4%	27.5%
MgO	-	5.0%	3.8%	4.1%
Al_2O_3	-	15.0%	12.5%	11.9%
SiO_2	-	60.0%	60.3%	56.5%

Glass No. 1 is a base glass especially adapted for a high grade textile glass, and Nos. 2 and 3 are glasses preferably for insulating wool glasses. No. 1 is slightly more difficult to melt but imparts the most desirable properties. No. 3 is the easiest to melt. All of them, however, are easy to melt and have high resistance to devitrification.

In practice it has been found expedient to modify the simple or base glasses. This is accomplished by the addition of auxiliary fluxes in amounts up to about 10%. The introduction of auxiliary fluxes does not disturb the relationship of the ingredients in the base glasses. Rather they are supplementary to the base glasses and assist in the melting or handling of the glass.

Examples of suitable auxiliary fluxes are B_2O_3, CaF_2, P_2O_5, or, if circumstances permit, a small amount of alkali such as Na_2O, K_2O, or lithia. The addition of lithia may be raised in some case up to 5%.

These fluxes have the effect of increasing the viscosity range and/or lowering the melting temperature, decreasing the time required for melting, and lowering the softening point. By their use we may adjust the properties of the simple glasses to meet the requirements imposed by manufacture of economics for a wide variety of products. The addition of these auxiliary fluxes, however, does not affect the basic combination of the glass-forming ingredients, but merely facilitates control and melting properties of the glass. Specific examples of glasses which use auxiliary fluxes are as follows:

		4.	5.	6.	7.
CaO	-	18.0	16.0	20.4	19.3
MgO	-	4.5	4.5	3.4	3.5
Al_2O_3	-	15.0	15.0	10.0	10.5
SiO_2	-	53.0	53.0	54.2	54.7
B_2O_3	-	9.5	9.5	9.0	6.9
CaF_2	-	0.0	2.0	3.0	2.0
Na_2O	-	0.0	0.0	0.0	3.1

Softening Point 1560° F. 1500° F. 1470° F.

Compounds beneath the line may be regarded as auxiliary fluxes. Glasses Nos. 4 and 5 are particularly adapted for textile purposes. Glasses Nos. 6 and 7 are particularly adapted for insulating wool and the like. If a product is desired which is inexpensive and has a high electrical resistance, fluorospar may be substituted for the soda in glasses Nos. 7 and 8. Such glasses may be melted and founded in the usual day or continuous tanks with only slight alterations of practice. These glasses have frequently been

made in ton loads in day tanks without exceeding 1420° C. on a twenty-four hour cycle. Occasionally with lower temperatures, and also in higher silica ranges, absorption of the silica of the batch is slower and desirable effects are obtained by the addition of one or two percent fluorospar. Sulphates also promote the solution of silica, but have a tendency to blanket the glass with foam which is often difficult to break. No unusual corrosion of refractories is encountered at the melting temperatures.

A non-alkaline glass for the production of glass fibres may have the composition:

Calcium oxide	-	16 to 18%
Magnesium oxide	-	4 to 5%
Alumina	-	13 to 17%
Silica	-	53 to 55%

With up to 10% of non-alkaline auxiliary fluxes.

For the production of fibres from the non-alkaline glasses any of the usual methods may be employed. There may be used for example, with advantage the method of producing the fibres by the aid of blasts, such as found in the Trigg's British Specification No. 428,720, but the various methods of mechanical drawing may likewise be applied.

Glass fibres produced by such methods may be extremely fine having diameters, for example, of the order of magnitude of about .0001 to .0003 inches more or less. The fibres or filaments may be successfully fabricated into strands, twisted yarns, ply yarns, and then interwoven, knitted or braided into various fabrics. Such fabrics have extremely high electrical resistance and resistance to moisture and other deleterious effects.

When subjecting fibres according to the invention to steam for a period of forty-eight hours, a treatment which destroys fibres of an alkali glass, no detectable deterioration occurs. When heated to 300° C., fibres of this alkali free glass will gain about 20% in tensile strength while fibres of alkali glass will lose about the same amount.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A glass for the production of glass fibres substantially composed of calcium oxide, 16 to 30%; magnesium oxide, 1 to 7%; alumina 7 to 17% and silica 53 to 67%, and free from alkali or containing not more than 5% thereof.

2. A non-alkaline glass for the production of glass fibres according to Claim 1, composed of calcium oxide, 18 to 28%; magnesium oxide, 1 to 7%; alumina 9 to 17%; and silica, 55 to 65%.

3. A non-alkaline glass for the production of glass fibres according to Claim 1, composed of 27% calcium oxide, 4% magnesium oxide, 9% alumina and 60% silica.

4. A non-alkaline glass for the production of glass fibres according to Claims 2 or 3, having an addition of fluxes in amounts up to 10%.

5. Glass fibres made from a glass according to Claim 1 or Claims 1 to 4.

6. Glass fibres, more particularly for textile purposes, made from a glass according to Claim 1 or Claims 1 to 4 having the composition: calcium oxide, 16 to 18%; magnesium oxide, 4 to 5%; alumina 13 to 17%; and silica 53 to 55%.

7. Glass, or fibres made therefrom, having any of the compositions specified under the headings 1 to 7 hereinbefore described.

Dated this 15th day of October, 1938.

EDWARDS & CO.,
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